

CLAIMS:

- 1 1. A detector assembly for improved depth of interaction determinations comprising:
2 a scintillator crystal for interacting with a photon and creating a plurality of
3 optical signals, said scintillator crystal having a first end and a second end;
4 a first transducer for receiving one the plurality optical signals from said
5 scintillator crystal and converting the one the plurality optical signals to a first electrical
6 signal, said first transducer having a first active area for receiving optical signals, and
7 said first active area of said first transducer being optically coupled to the first end of said
8 scintillator crystal;
9 a second transducer for receiving another of the plurality optical signals from said
10 scintillator crystal and converting the one the plurality optical signals to a second
11 electrical signal, said second transducer having a second active area for receiving optical
12 signals and said second active area of said second transducer being optically aligned for
13 receiving optical signals from second end of said scintillator crystal; and
14 an optical guide, said optical guide optically coupled between said second end of
15 said scintillator crystal and said active area of said second transducer, said optical guide
16 being conducive to direct optical signals to said active area of said second transducer.
- 1 2. The detector assembly recited in claim 1 above, wherein said first active area is
2 larger than said second active area.
- 1 3. The detector assembly recited in claim 1 above, wherein said scintillator crystal
2 further comprising:
3 a plurality of slits, each of said plurality of slits being approximately equal in
4 length.

1 4. The detector assembly recited in claim 1 above, wherein said second transducer is
2 one of a photodiode and further comprises:

3 a semiconducting material, said semiconducting material having a low photon
4 absorption rate and a low photon scattering rate.

1 5. The detector assembly recited in claim 4 above, wherein said second transducer is
2 one of a photodiode and an avalanche photodiode (APD).

1 6. The detector assembly recited in claim 4 above, wherein said second transducer is
2 an avalanche photodiode (APD).

1 7. The detector assembly recited in claim 5 above, wherein said first transducer is a
2 photomultiplier (PMT).

1 8. The detector assembly recited in claim 1 above further comprises:
2 a third transducer for receiving one of the plurality of optical signals from said
3 scintillator crystal and converting the one of the plurality of optical signals to a third
4 electrical signal, said third transducer having a third active area for receiving optical
5 signals, and said third active area of said first transducer being optically coupled to the
6 first end of said scintillator crystal.

1 9. The detector assembly recited in claim 5 above, wherein said first and third
2 transducers are photomultipliers (PMT) and said second transducer is an avalanche
3 photodiode (APD).

1 10. The detector assembly recited in claim 9 above, wherein said scintillator crystal
2 being optically coupled between a plurality of optical guides and a plurality of
3 photomultipliers (PMT).

1 11. The detector assembly above in claim 1 recited, wherein said first electrical signal
2 is related to a first distance from the first active area of the first transducer and an
3 interaction point where said photon interacted with said scintillator crystal.

1 12. The detector assembly recited in claim 11 above, wherein said second electrical
2 signal is related to a second distance from the second active area of the second transducer
3 and the interaction point.

1 13. The detector assembly recited in claims 12 above, wherein a depth of interaction
2 (DOI) for the photon in said scintillator crystal is determined from said first electrical
3 signal, said second electrical signal and a distance between said first and second ends.

1 14. The detector assembly recited in claim 1 above, wherein said scintillator crystal
2 further comprises:

3 a bismuth germanate (BGO) crystal.

1 15. The detector assembly recited in claim 1 above, wherein said scintillator crystal
2 further comprises:

3 a plurality of bismuth germanate (BGO) crystals.

1 16. The detector assembly recited in claim 1 above, wherein said scintillator crystal
2 further comprises:

3 a sodium iodate (NaI) crystal.

1 17. The detector assembly above in claim 1 recited, wherein said scintillator crystal
2 further comprises:

3 a plurality of sodium iodate (NaI) crystals.

- 1 18. The detector assembly above in claim 1 recited, wherein a distance between said
- 2 first and second ends exposes an oblique angle to a photon.